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Sharing teacher experiences of teaching with technology in the classroom: analysis, design and development process of a web-based case library

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Abstract

The Web-based case library for the use of education technologies in classes was developed as part of a scientific project, which aimed at revealing the successful examples of teachers' use of information technologies for instructional purposes in primary schools in Turkey. Its importance is due to its facilitation of experience-sharing among teachers, especially with candidate teachers, bridging the gap between theory and practice, and additionally, diffusion of innovations-related changes. To this end, an internet-based database was created by compiling the case studies obtained by interviews and observations in schools. This database was then transformed into a Web-library equipped with visual elements by means of an efficient classification system.

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Keywords: Case library; Instructional technology; Case-based instruction.

1. Purpose of the Study

Use of information and communication technologies (ICT) in elementary schools increases in worldwide (Akkoyunlu & Orhan, 2001; Hew & Brush, 2007). However, providing tools and equipment s does not assure integrating these technologies into teaching and learning (Askar & Usluel, 2003; Lawless & Pellegrino, 2007). Appropriate methods are needed to integrate technology into education. One method is case method teaching (Jonassen, 1996). Using cases in education and training, especially in medical, law, and economics education, is a widely accepted and applied practice in higher education (Williams, 1992). The reason behind using real life cases for education lies underneath the tenets of constructivist learning environments. The real life cases provide a realistic and ill structured operation domain for students' learning activities (Schank, Berman, & Macpherson, 1999). Students examine the conditions of the case, understand and analyze the problem(s) related to the case and propose solutions based on their understandings of the case. Case based method of instruction facilitates case based reasoning, student critical thinking skills, and long term retention and transfer of the knowledge to different cases. Similarly, cases related to integrating ICT technologies into teaching and learning process have potential to facilitate effective teaching and diffusion of ICT among the pre-service teachers.

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The Web-based case study library obtained as a result of this study was developed in order to share the cases related to the use of technology in primary school courses and the electronic sources utilized by teachers. The origin of the Web-library, this research aims at finding out the cases about the use of information technologies by teachers in primary schools in Turkey, and investigating the types of these technologies and their use. The phases of the research are compiling the cases obtained from the interviews and observations in schools, developing the internet-based case library framework, entering data to the library and examining the effect of this media on the diffusion of innovations by means of using this media in the training of teacher candidates. The data gathered were structured to make them easily-transferred to other teachers and teacher candidates. At this point, the importance of a Web application that is analyzed, designed and developed in a carefully planned process arises.

The feedback to be obtained at each level of the research process will be used as data for updating the Web-based case library. Therefore, the development level is a dynamic one that spreads over an extended time frame.

2. Method

The development of the Web application was designed in five phases. The first phase is the analysis of the database that constitutes the basis of the application. Considered as the most important phase, it naturally became the most time-consuming phase in the analysis and design process. The importance of this phase is yet again underlined by the necessity of the Web application to have a rather developed query system, as to suit the aim of the project.

The second phase was the design of the database that was analyzed. This phase included above all the theoretically design of the tables in the database, the fields in the tables, the probable values of these fields and the determination of data types. Afterwards, this design was transferred to MySQL database system.

The third phase was the application analysis. The key necessities in line with the aim were put forth in this process.

The conceptual design of the screens to be developed as indicated by the necessities that emerged as a result of the analyses on the fourth phase was followed by the coding phase. In this phase, the PHP (Hypertext Preprocessor) coding to perform the database operations and JavaScript coding to programmatically reach the objects were done as integrated in the CSS-aided (Cascading Style Sheets) HTML (Hypertext Markup Language) pages. Each phase is approached as separate sections further in this study.

The fifth and last phase included the usability tests to evaluate the effectiveness of the application developed and the necessary corrections and additions in the system were made corresponding to the data gathered from the users in the evaluation phase.

3. Database Analysis and Design

3.1. Analysis

The database analysis started with profiling the case and the related themes. Having as well a significant role in generating the interview forms for the teachers, these profiles were designed in detail by taking into account all the probable queries on the database.

Another element to which attention was paid while designing the profiles was gathering the responses to be given under common headings by categorization as much as possible. This operation is important in terms of increasing

the variety of categorization of the cases. Based on grouping the probable responses under common headings during the analysis phase, this study was carried on in parallel with the interviews and the database was updated when necessary in line with the feedback obtained during the project.

In addition, for almost all of the questions there was an open-ended response option as “other”. Thus, it was planned to obtain some important details that could be used in the qualitative analysis of the research data.

The profiles for the case and the related themes are as follows:

- User profile
- School profile
- Teacher profile
- Case profile

Each profile was structured by the best possible defining questions.

3.1.1. User Profile

User profile includes the personal information about the system users and determines user name, password and user types. Three types of uses were designed:

- System Manager: The most authorized user type who has both all the authorization on the data and to make changes in the database. Besides, the system manager is authorized to display system logs.
- Researcher/Research Assistant: Users that can enter and correct data into all profiles except for the user profile.
- Anonymous User: Users whose access to the system is confirmed via Internet and who can enter data into all profiles except for the user profile.

3.1.2. School Profile

It is composed of the questions to determine the demographic data, socio-economic level and technological infrastructure of the school in the case.

3.1.3. Teacher Profile

It is composed of the questions on personal information and the level of familiarity of technology of the teacher who details the case.

3.1.4. Case Profile

The Case Profile is the most detailed one which is designed to perfectly describe the case. The questions regarded the level of class, subject area, place, place characteristics, activities employed, the roles of teachers and students in the case, technologies used, resources referred and contributions to students.

3.2. Design

The phase of the conceptual planning of the database comprises determining the tables that constitute the database and the attributes of the fields present in these tables. In this phase, the technical infrastructure was created by using the themes that were determined during the analysis phase. This infrastructure was generated in Excel work sheet format to be directly used in the database system.

When the tables are observed, four main fields draw attention. The first is the *id* field that will provide the uniqueness of the record. The values of these fields were generally determined as automatically ascending numbers for each table.

The second type of field has one response and it is where the data of this response should be entered in the free text field. A typical example could be the field where the story related to the case will be entered.

The third type of field has one response as well but the response is multiple choices, such as the class level and the number of students.

The fourth type of field is designed as a synthesis of the second and the third. In these fields, the responses could be given by choosing from a set of options or by means of inserting a free text. In order to enable the user to choose more than one option and to make detailed queries, these fields were designed as separate fields for each response. For instance, the options “application”, “information search” or “data analysis” for the question “Which activities did you use in this lesson?” were determined each as an independent field in the database. In addition, there is the “other” field in which the user can enter text for the same question.

The database design phase was completed by transferring the defined database tables to MySQL database system. The system is designed in a way that enables further field descriptions for the possible future necessities that might arise during entering the data obtained during and after the interviews.

4. Application Analysis, Design and Development

The Web application to be developed is planned as three-layer architecture. The first tier is the database created in MySQL system. The second one is composed of the coding written by PHP programming language. The function of these codes is to connect the application interface in the first layer to the database and to enable the interaction between the application and user.

In the first phase of the application development, the control panel that enables data entry and update by the researchers. Therefore, the priority in the design process is given to this issue. The second phase was interface design and query coding.

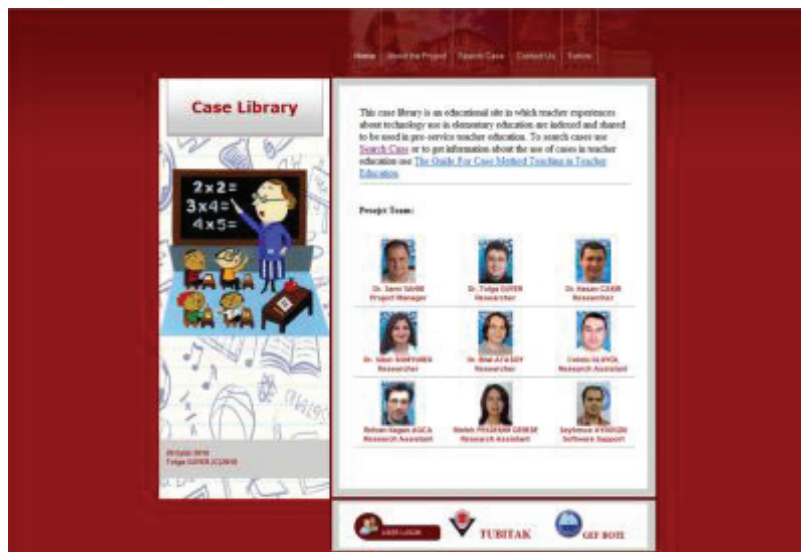


Figure 1. Home page of the application (<http://www.ornekolay.org/indexe.html>)

The interface developed for case query has mainly two different search systems. The first one is the search based on keywords within the case story. The second search system was named “categorized search”. This system enables search according to 18 different categories.

These categories are as follows:

Search by;

- the case id,
- the class level;
- the subject area,
- the number of the students,
- the learning environment,
- the type of the activity,
- the learning outcomes of the students,
- the technology,
- the technology usage reason,
- the support,
- the way of skill to win of the students,
- the learning skills of the students,
- the student’s reaction,
- the role of the teacher,
- the role of the students,
- the teacher,
- the researcher,
- the school.

The system operates on the basis of a two-level *tree-type* menu which is generated according to the category entered, and located on the left-hand side of the screen. From this menu structure, developed dynamically as connected to the database, the number of records under each category could be seen by means of the numbers next to the category labels. When the categories are clicked, the case records underneath are displayed with brief explanations.

Each case belonging to the case record clicked, and some of the school and teacher profile information are displayed in the accordion-style menu system on the right-hand side. In this way, the cognitive overload that might arise for the users due to being subject to too much information in the same screen was sought to be avoided.

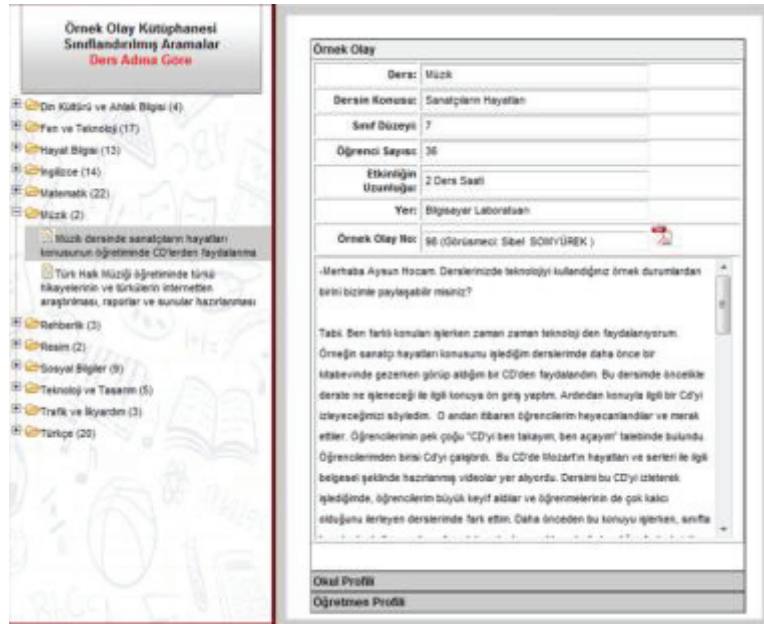


Figure 2. Results of the classified searches

The user, if preferred, can easily access to the profile information about the school or the teacher who details the case belonging to the case displayed in this menu system.

Among the case records found, when the *pdf* symbol next to the case number is clicked, brief information related to the case is displayed in a new window, and thus, legibility is obtained. The user can save this folder also to his/her computer. The *material* symbol, which appears in some cases next to this symbol, opens a window that includes the links to the documents related to the case that are sharable in Web, if exist.

5. Usability Evaluations

It is necessary that the technological applications developed be evaluated in terms of capability to realize the operations desired and whether the focus target group could use it easily. The evaluation process enables figuring out the halting and lacking aspects and rendering the software more effective and efficient of the software. Usability tests were conducted in order to evaluate the Web-based Case Library that was developed for the present project. International Standards Organization (ISO) defines usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO/DIS 9241–11, 1994, Crawford, Taylor and Wan Po, 2001).

Nielsen (1993) states that five participants are sufficient to conduct usability tests and 75% of the usability problems could be determined by tests conducted with this amount of participants. At this stage, the usability of the system was evaluated with a participant group of 20 teachers and teacher candidates. The effectiveness, efficiency and user satisfaction of the software were measured according to the interactions of the users with the Case Library.

The effectiveness of the application was measured by observing whether the users could carry out the tasks assigned to them by using the software. Efficiency, on the other hand, was measured by the time spent and the

number of mistakes made by the users while carrying out these tasks. User satisfaction was measured by interviews with the participants that took place after they completed these tasks.

The participants were asked to define six tasks that comprise the main functions of the system. While the participants were carrying out these tasks, alone and each in different moment, the researchers noted the time spent and the number of mistakes. The participants were asked complete all the tasks by starting from the first and they did not receive any help from the researchers while carrying out these tasks. Each participant was interviewed right after completing the tasks and the data related to the effectiveness, efficiency and user satisfaction were gathered verbally.

5.1. Effectiveness and Efficiencies of the Application

All of the twenty participants successfully completed the six tasks assigned to them. However, each participant made a mistake in the nine operations required by these six tasks while carrying them out. The users made 63 (35%) mistakes among 180 operations. It could be stated that this error rate is not high, considered that the users used the software for the first time. It is known that the first-time users make mistakes when using even software with a well-designed interface for some time. Moreover, psychological and environmental factors cause errors regardless of the perfect design of the software application and the experience of the user. In addition, the aspects of software may not be suitable for all users due to individual differences. Hence, the error rate of software is considered acceptable for the first-time use.

5.2. User Satisfaction

Table 1 shows the general satisfaction level of the users with the application.

Table 1. Satisfaction level

Satisfaction Level	f	%
I liked it a lot	15	75
I liked it	5	25
Undecided	0	0
I didn't like it	0	0
I didn't like it at all	0	0
Total	20	100

It is observed from the satisfaction points related to the use of the program that 15 participants stated that they “liked it a lot” and two participants “liked it”. This result shows that the level of satisfaction with the software is high among the users.

Table 2 shows the users’ reflection on the ease of use of the application. The findings in this table demonstrate that the 80% of the participants found the use of the application “very easy” and the rest of the participants found it “easy”.

Table 2. Ease of use of the application

Ease of Use	f	%
Very Easy	16	80
Easy	4	20
Undecided	0	0
Not easy	0	0
Not easy at all	0	0
Total	20	100

All of the participants responded positively to the question “Referring to the case you read, could the speeches of the researcher and teacher in the case story presentation be easily distinguished?”. Likewise, all the participants responded positively to the question “By making use of the case story, can a similar one be used in classes?” and they furthered that these cases gave an idea about technology use and directed the users. These two questions are significant for the system to reach its goal. Whereas most of the participants responded to the question “Is the information provided in case presentations about the case, school profile and teacher profile sufficient? What other types of information would you like to see?” by “sufficient”, one user proposed putting photographs of the teachers in the system. However, as this could be realized only by the authorization of the schools and teachers, it has not been applied yet.

Some of the users critically responded to the questions “Were the menus sufficiently clear and comprehensible?” and “Was access to the information you sought in the case search clear and comprehensible?”, stating that the various criteria in the case search option were confusing. Thus, the categorized searches in the case search section were updated and presented as groups to the user in line with the ideas of the users.

As a result of the general data obtained by the usability study, it could be stated that the system is an effective, efficient product that generates user satisfaction. As the necessary corrections indicated by the data gathered during the evaluation phase were reflected in the system, it is thought that the usability level of the system increased.

6. Conclusions

As much as the theoretical and empirical studies conducted within a scientific discipline are important, so are the descriptive studies towards gathering qualitative and quantitative data conducted within the application areas of the research results. However, the results obtained in these studies, as they are directly related to application areas, should be presented to the individuals working in these areas. In this respect, the most suitable medium to present the results of our study conducted directly on teachers was considered the Internet. The Web-based application developed in this study was envisioned not only as a guide for the researchers studying on similar topics for the Web-based presentation of the qualitative and quantitative data, but also as an accessible data resource for teachers who are the first degree addressee of the results of this study.

The usability evaluation provided rather important feedbacks for increasing the quality of the system. The ideas derived from these feedbacks were then highly reflected to the system.

Finally, the Web-based case library is expected to be employed in primary schools to spread the use of technology and to become a point of reference for researchers interested especially in case-based learning and instructional technology use.

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